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Memorandum

Date: May 10, 2001

From: Michael J. Riley

To: Halah Voges

Subject: Skykomish Model Comment from URS

Comments on the Skykomish Groundwater Model Technical Memorandum were provided by Gregory Burgess of URS to Nnamdi Madakor of the Washington Department of Ecology. The comments are based on a slightly different interpretation of the hydrologic effects of the Skykomish River on groundwater flow patterns. However, it should be recognized that this alternative interpretation would not change the results of the model with respect to the effect of the shallow LNAPL interception wall on groundwater flow patterns and water level mounding upgradient from the wall.

I have reviewed the comments and broken them out as follows.

1. The Technical Memorandum states "the exterior boundaries of the model area are no-flow boundaries, which means that groundwater flow is generated through constant head, specified flows and recharge within the model area". In my opinion, this language is contractidory. Either a boundary is no flow, general head, or constant head not both or all three. No flow means no flow.

Response: This statement caused some confusion to Ecology as well and will be revised. The intent is to describe the boundary of the model domain as no flow boundaries. However, some Skykomish River and Maloney Creek cells are on the boundary of the model domain. Constant head cells are used to simulate the Skykomish River, and the river package is used to simulate Maloney Creek. With respect to the potential for a boundary to have more then one definition, MODFLOW does not limit the user to only one boundary specification within a cell.

2. Secondly, the memo states "the Skykomish River is treated as a MODFLOW constant head boundary. In the eastern portion of the model where the river is higher, the river contributes flow to groundwater. To the west where the river is lower, the river receives flow from groundwater". The model assumes that water flows from the river to groundwater in the east portion of the model domain, migrates west and flows from groundwater to the river in the western portion of the domain. This implies that groundwater flow in the model domain is driven only by the river.

Response: The flow pattern in the model domain is a combination of the flow contributed from the Skykomish River, Maloney Creek and recharge. The groundwater head

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contours clearly show that there is strong component of flow from the south, which is from the Maloney Creek watershed. The primary effect of the Skykomish River is to provide a discharge boundary with a water level slope from east to west. This causes the groundwater contours to be oriented to the northwest and west rather than directly north, which would be the case if the Skykomish River had a constant rather than sloping water level. Similarly, if Maloney Creek was not present, there would still be groundwater contours trending from east to west in the alluvium. While the Skykomish River influences the shape of the groundwater contours, the primary driver on groundwater flow is the contribution form the Maloney Creek watershed.

3. Typically, flow models are setup whereby the regional groundwater flow is influenced locally by rivers, not driven by rivers. The setting is a narrow, glacio-fluvial sediment filled valley with sediments up to 250 feet thick. The valley is very long and likely has a regional groundwater flow from east to west downgradient with the valley. Locally, the river influences groundwater flow in both the vertical and horizontal plane, but, it is not necessarily the driving force. It is the no flow boundaries on the eastern and western edges of the domain that confuse me. I would think that they should be constant head boundaries or at the very least general head boundaries. This would allow flow into and out of the domain on a regional level with the river influences superimposed.

Response: Groundwater flow must be partly driven by the river as the river is the discharge point for shallow groundwater flow. The model was conservatively constructed to represent only the upper 40 to 50 feet of the aquifer. Flow in this region of the aquifer is inferred to discharge to the river based on water level measurements and groundwater level contours of the measurement data.

I differ in my interpretation of the Skykomish River valley near Skykomish. The town is situated on an alluvial fan from Maloney Creek, which forces the main channel of the River against the hills along the north bank of the river. The alluvial fan is bounded to the east and west by topography. In addition, if the slope of hills that bound the alluvial fan are extended to the north in the subsurface, it is clear that the valley along the south bank of the river must be very narrow. Therefore, any regional flow down the river valley would be minor.

Based on these considerations and the greater uncertainty associated with selecting a constant head or defining a general head boundary beyond the limits of data available at the site, the south overbank area of the Skykomish River was treated as a no-flow boundary.

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